

Efectis Nederland BV
Centre for Fire Safety
Lange Kleiweg 5
P.O. Box 1090
2280 CB Rijswijk

Efectis Nederland report

2010-Efectis-R0427

**Determination of the fire resistance according to EN
1634-1: 2008 of a steel double leaf door-/ frame
construction**

www.efectis.nl

T +31 15 276 34 80
F +31 15 276 30 25
E nederland@efectis.com

Date April 2010
Author(s) P.W.M. Kortekaas
Dr. Ir. G. van den Berg

Number of pages 21 (excluding appendices)
Number of appendices 3 (A to C)

Sponsors Alara Lukagro B.V.
Postbus 15
2964 ZG GROOT-AMMERS

Project name Fire resistance
Project number 2009522

All rights reserved.

No part of this publications may be reproduced and/or published by print, photoprint, microfilm or any others means without the previous written consent of Efectis.

In case this report was drafted on instructions, the rights and obligations of contracting parties are subject to either the Standard Conditions for Research Instructions given to TNO, or the relevant agreement concluded between the contracting parties. Submitting the report for inspection to parties who have a direct interest is permitted.

© 2010 Efectis Nederland BV: a TNO company

This report is issued by Efectis Nederland BV (previously TNO Centre for Fire Research). Efectis Nederland BV and her sister company Efectis France are full subsidiaries of Efectis Holding SAS since 1 January 2008, in which the Dutch TNO and the French CTICM participate. The activities of the TNO Centre for Fire Research were privatized in Efectis Nederland BV since 1st July 2006. This is in response to international developments and requests by customers. In order to be able to give a better answer to the customer's request and offer a more comprehensive service of high quality and a wider range of facilities, the international collaboration has been further expanded. This is done with highly experienced partners in fire safety in Norway (Sintef-NBL), Spain (Afiti-Licof), Germany (IFT), USA (South West Research Institute) and China (TFRI). Further information can be found on our website.

Contents

1	Subject	3
2	Examination	3
3	Sponsor	3
4	Place and data regarding the examination	3
5	Date and number of the report	3
6	Test specimen	4
6.1	General.....	4
6.2	Double door leaf.....	4
6.3	Framework.....	4
6.4	Hardware.....	5
6.5	Sealing profiles.....	5
6.6	Intumescent strips.....	5
6.7	Fixings.....	5
6.8	Test frame and supporting construction.....	6
6.9	Method of assembly.....	6
7	Sampling and manufacturing of the construction	6
8	Mode of testing.....	6
8.1	Verification of the specimen.....	6
8.2	Conditioning.....	6
8.3	Density and moisture content.....	6
8.4	Gap widths.....	7
8.5	Pre test-conditioning.....	7
8.6	Fire test.....	7
9	Test results.....	8
9.1	Observations during heating.....	8
9.2	Graphs of the fire test.....	8
9.3	Uncertainty of measurement.....	8
10	Summary	8
11	Field of direct application and conditions.....	9
12	Parts list	11
13	Figures	12

Appendices

- A Measurements
- B Furnace conditions
- C Test results
- D Photographs

1 Subject

A double leaf door-/ frame construction, type AL-D/D 50-B fabricated by Alara Lukagro. The construction was mounted in an aerated concrete supporting construction.

2 Examination

Determination of the fire resistance according to EN 1634-1: 2008 for the case, “door pivoting away from the fire”.

3 Sponsor

Alara Lukagro B.V.
Postbus 15
2964 ZG Groot-Ammers

4 Place and data regarding the examination

The examination was performed at the laboratory of Efectis Nederland BV in Rijswijk, The Netherlands.
The wall construction was prepared in week 51-2009.
The specimen was assembled on the 23rd of December 2009.
The open and close cycle was performed on the 4th of January 2010.
The fire test was performed on the 5th of January 2010.

5 Date and number of the report

April 2010; 2010-Efectis-R0427.

6 Test specimen

6.1 General

See chapter 12 for the parts list

A fire test was carried out on an steel double door leaf-/frame construction, with external dimensions of 2106 x 2383 mm (w x h), consisting of:

- Double leaf steel door ;
- Steel door frame.

For the dimensions and specifications of the materials and components of the examined construction, see figures 1 until 9 in chapter 13. Significant details of the construction are given in the paragraphs below.

6.2 Double door leaf

General

Dimensions of each door leaf:

- height: 2383 mm;
- width: 1053 mm;

The door leaf was constructed of:

- 1.5 mm Zincor steel plate (3)¹;
- 76.5 mm thick Rockwool 750 filling, 115 kg/m³ (2);
- 2.0 mm Zincor steel plate (1);
- Kerafix bauplatte S (4), dimensions 76.5 x 15 mm around the edges of the doorleafs.

6.3 Framework

The doorframe consisted of

- Steel thickness 2.0 mm
- Nominal dimensions 67 x 107 mm
- Filling of the doorframe Kerafix Bauplatte S (4) multilayer built up.

¹ The numbers between the brackets refer to the materials mentioned in the parts list in chapter 12

6.4 Hardware

. . Lock

- Type : BMH 4114 in te active leaf with a panic bar
BMH 6130 in the passive leaf with a panic bar
- Lockplate : 255 x 24 mm steel
- Handle : steel
- Top lock : operated by the main lock

. . Dog bolts (11)

- Number : on the hinge side of each of the doors three dog bolts
- Diameter : 13 mm.
- Positions : at 5 cm from the top and bottom of the door and at half height

. . Hinges (10)

- Type : ALD hinge (10) diameter 20 mm, height 175 mm
- Number : 3 per door leaf
- Positions : at 200 mm from the top and bottom of the door leaf and at half height

6.5 Sealing profiles

- ALD seal non flammable (5), dimensions 20 x 25 mm used between the doors and the doorframe and between the doors
- Non flammable mastic (7) type Pyropol between the door frame and the supporting construction

6.6 Intumescent strips

- Type : Kerafix flexpan intumescent strip (6)
- Dimensions : 25 x 2 mm
- Number : 2 strips
- Used : between the door and the doorframe and between the doors

6.7 Fixings

- ALD adjustable fixing device
- Metain tapper 6.0 x 75 mm minimum one per hinge, four on header see figure 2.

6.8 Test frame and supporting construction

Test frame

The test frame was constructed of a concrete frame, with internal dimensions of 4000 x 3000 mm (w x h).

Standard Supporting construction

The frame was fixed to an aerated concrete wall with a thickness of 150 mm.

6.9 Method of assembly

- Mounting of the frame construction
- Mounting of the door construction

7 Sampling and manufacturing of the construction

Alara Lukagro B.V.

Efectis Nederland BV
Centre for Fire Safety

Delivery and mounting of the door
construction
Test frame

8 Mode of testing

8.1 Verification of the specimen

The materials and components used were inspected during assembly on the basis of the supplied drawings and data.

8.2 Conditioning

From the moment of assembly until the fire test the construction was stored in the laboratory of Efectis Nederland BV with the following conditions:

- Ambient temperature: $20 \pm 5^\circ\text{C}$.
- Relative humidity: $50 \pm 10\%$.

8.3 Density and moisture content

Table 1: Density and moisture content

Material	Density [kg/m ³]	Moisture [%]
Aerated concrete	630	4.5
Mineral wool	115	0.3

8.4 Gap widths

Prior to the test the gap widths were measured.

8.5 Pre test-conditioning

Operability test

Prior to the commencement of the fire test the door construction was checked for operability, to open the doors 25 times from fully open position (90°) to fully closed position with the help of the door spring.

8.6 Fire test

Table 2: Pre test-conditioning

Test conditions	
Cycles	25 times manually
Opening time	4 seconds
Closing time	6 seconds
Cycle time	10 seconds
Period at rest between the cycles	4 seconds

Test conditions

The construction was tested for the case door pivoting away from the fire. The fire test was carried out according to EN 1634-1:2008. This also includes that during the fire test, plate thermocouples were used to measure the gas temperatures in the furnace and the overpressure targets in the furnace for 0.5 m above floor level and at the top of the construction were 0 and 20 Pa, respectively.

Measurements

During the heating the following data was measured and registered:

Furnace conditions

- the temperatures in the furnace using plate thermocouples equally spread over the heated surface;
- the pressure in the furnace (Press-0.5 and Press-2.7).

Specimen

- surface temperature of the door leaves;

- surface temperature of the steel frame;
- radiation at 1.0 m from the double leaf door;

Environment

- the air temperature in the laboratory outside the furnace (TAMB).

The positions of the thermocouples were given in the figure B.1.

Observations during the test

Time [min]	Observation
0	Start heating
8	Light smoke development near the middle joint of the door
39	Temperature rise > 180°C at thermocouple 22
41	Temperature rise > 180°C at thermocouple 11
78	Sustained flaming at the lock

9 Test results

9.1 Observations during heating

The details of the observations are listed below.
Photographs of details during assembly and the construction before, during and after the test are shown in annex D.

9.2 Graphs of the fire test

The test results are shown as graphs in Annexe B and C.
During the heating of the specimen the ambient temperature met the requirements of EN 1634-1:2008.

9.3 Uncertainty of measurement

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of the fire resistance, it was not possible to provide a stated degree of accuracy of the result.

10 Summary

The fire resistance was determined of a steel double door-/frame construction, type AL-D/D 50-B. The examination was performed according to EN 1634-1:2008 for the case, “doors pivoting away from the fire.”

Table 3: Summary of test results

Criterion	Time measured from the start of the test during which the criterion based on EN 1634-1:2008.
a) Integrity (E) – Cotton pad – Opening gauges – Flames > 10s	78 minutes failed 78 minutes no failure 78 minutes failed
b) Thermal insulation (I) – Average temperature increase – Maximum temperature increase (I ₁) – Maximum temperature increase (I ₂)	78 minutes failed because of integrity 38 minutes failed 41 minutes failed
c) Heat radiation (W)	78 minutes failed because of integrity

Heating was terminated after 78 minutes at the request of the sponsor.

11 Field of direct application and conditions

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in EN 1363-1, and when appropriate EN 1363-2. Any significant deviation with respect to size, constructional details, load stresses, edge or end conditions other than those allowed under the field of direct application in the relevant test method was not covered by this report.

The results of chapter 10 were only valid for steel doors:

- a) Turning away from the fire for the criteria integrity, thermal insulation and radiation and turning towards the fire for the criteria integrity and radiation;
- b) For a fire resistance of 30 minutes the dimensions of the door construction may be enlarged by the following percentages:
 - 15 % in height
 - 15 % in width
 - 20 % in surface area
- c) the type of metal shall not be changed
- d) the number of stiffening elements for uninsulated doorsets and the number and type of fixings of such members within the panel fabrication may be increased proportionally with the increase of size but not reduced;
- e) because a paint is not expected to contribute to the fire resistance a paint may be applied to the door construction
- f) the number of fixings used to attach the doorset to the supporting construction may be increased. The centre to centre distance of these fixings shall be increased;

- g) the number of any movement restrictors such as locks, latches and hinges may be increased but shall not be decreased;
- h) the door construction shall be mounted in a wall of stone like material with a thickness of at least 150 mm and a density of at least 600 kg/m^3 .



P.W.M. Kortekaas



Dr. Ir. G. van den berg

This report is issued by Efectis Nederland BV (previously **TNO** Centre for Fire Research). Efectis Nederland BV and her sister company Efectis France are full subsidiaries of Efectis Holding SAS since 1 January 2008, in which the Dutch TNO and the French CTICM participate. The activities of the TNO Centre for Fire Research were privatized in Efectis Nederland BV since 1st July 2006. This is in response to international developments and requests by customers. In order to be able to give a better answer to the customer's request and offer a more comprehensive service of high quality and a wider range of facilities, the international collaboration has been further expanded. This is done with highly experienced partners in fire safety in Norway (Sintef-NBL), Spain (Afiti-Licof), Germany (IFT), USA (South West Research Institute) and China (TFRI). Further information can be found on our website.